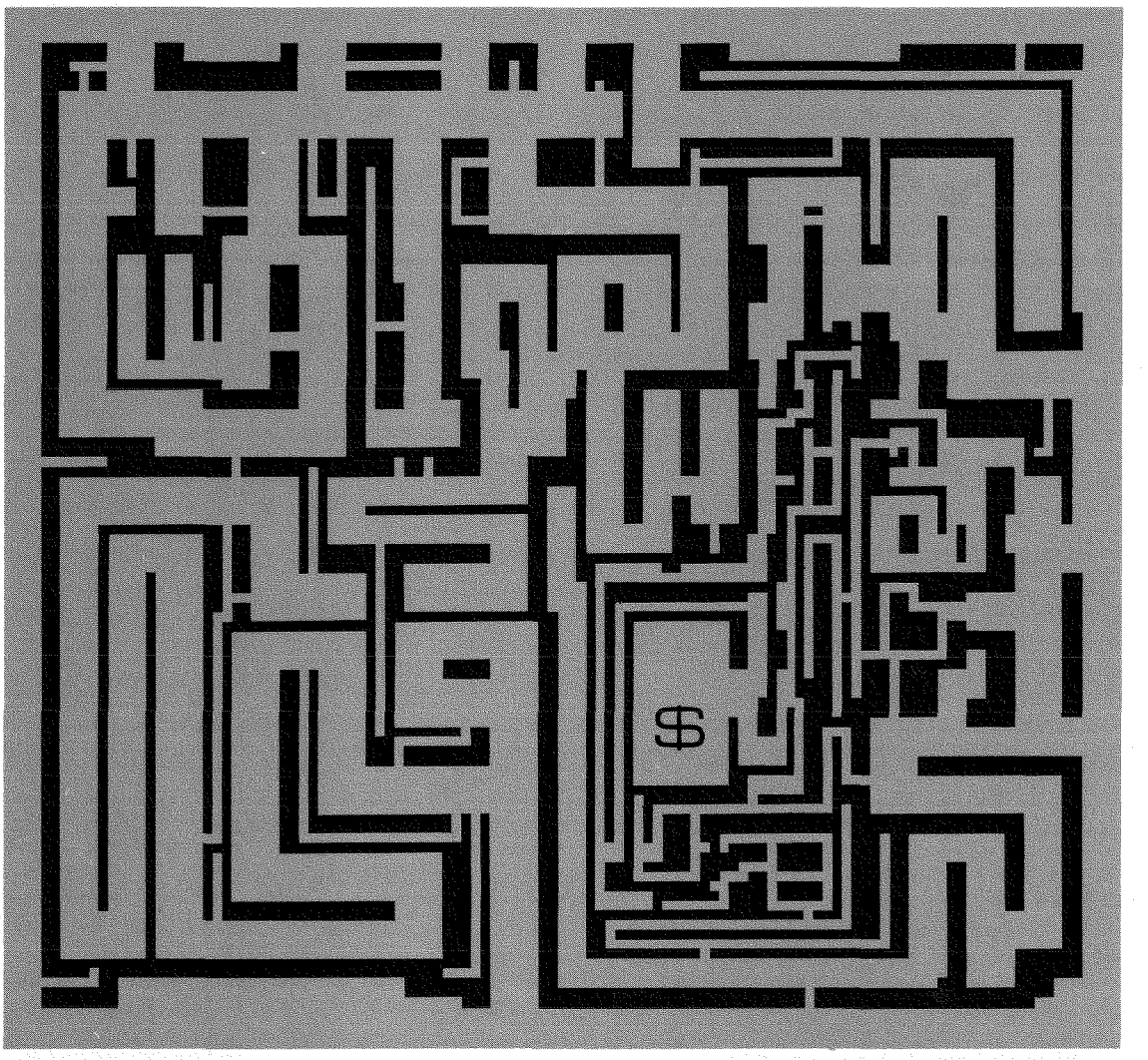
FEDERAL RESERVE BANK
OF SAN FRANCISCO

ECONOMIC REVIEW



CPI | WPI | M_1 | M_2 | M_3

ALTERNATE STRATEGIES TOWARD INFLATION

FALL 1979

Exchange-Rate Policies and Inflation: Theory and Evidence

Hang-Sheng Cheng

During the last decade, inflation has become a worldwide concern. At the same time, with the abandonment of pegged exchange rates under the Bretton Woods system, member countries of the International Monetary Fund (IMF) have become free to choose their exchange-rate policy under general IMF surveillance.[1] How to exercise this freedom so as to minimize domestic price inflation is obviously a question of considerable policy interest.

The purpose of this paper is to utilize economic analysis and empirical evidence to shed light on the subject of exchange rates and domestic inflation. We start with a simple model of a small two-sector economy—a tradable-good sector and a nontradable-good sector. With this model, we compare how various types of disturbances to the national economy (e.g., world inflation, capital flows, domestic wage increases, crop failures, monetary expansion) affect the domestic price level under fixed and flexible exchange rates. A large number of cases are analyzed, corresponding to the various alleged causes of inflation, to see if the choice of exchange-rate policy makes a systematic difference in the extent to which the domestic price level is affected by various internal and external disturbances.

The analysis shows, first, that in an open economy, any inflationary disturbance from whatever source always manifests itself as a pressure in the foreign-exchange market, in the form of a reserve change or an exchange-rate adjustment (or a combination of the two). The analysis also shows that the essence of an exchange-rate policy lies in a deliberate policy choice regarding the distribution of the "exchange-rate market pressure[2]" between reserve changes and exchange-rate adjustments. Depending on the source of inflation, the exchange-market manifestation may be an upward pressure on the national currency (i.e. exchange appreciation or reserve accumulation) or a downward pressure (exchange depreciation or reserve depletion). In the case of an upward pressure, exchange appreciation would always result in less domestic-price increase than reserve accumulation; in the case of a downward pressure, on the other hand, reserve depletion would always result in less domestic inflation than exchange depreciation. Thus, an optimal exchange-rate policy for minimizing domestic inflation would be to *permit exchange appreciation and resist depreciation*, regardless of the source of inflationary disturbances. Since the manifestations of the exchange-market pressure are readily observable, and the exact nature of the underlying inflationary disturbances is not, this policy rule would make policy choices considerably easier and more operational than having to decide about the sources of inflation—imported or of domestic origin, demand-pull or cost-push, attributable to monetary or real factors.

We have applied the rule to assess the actual exchange-rate policies and inflation experiences of four Pacific Basin countries: Japan, the Philippines, Korea, and Taiwan, during the 1968-78 period. Buffeted by both internal and external disturbances, the four countries experimented with a variety of exchange-rate policies during this period. Japan floated in 1973; the Philippines nominally floated in 1970 but in fact pursued a flexible-peg approach; Korea originally floated but then shifted to a pegged rate in 1972; and Taiwan maintained a pegged rate until the very end of the period, when it adopted a floating rate.

* Assistant Vice President and Economist, Federal Reserve Bank of San Francisco.

Despite the variety of avowed exchange-rate policies, all four countries except Japan exhibited a greater readiness to depreciate the currency than to appreciate. Even in Japan's case, both appreciations and depreciations were tempered by a "leaning-against-the-wind" policy, whereby the Bank of Japan intervened in the market to slow down or moderate the extent of exchange-rate fluctuations.[3] The aversion to currency appreciation resulted in rapid money growth and inflation in a number of episodes, notably for Japan during 1970-72, Korea during 1975-77, the Philippines during 1972-73, and Taiwan during 1972-73 and 1976-78. Actual currency depreciations meanwhile resulted in higher domestic-price increases than would have occurred under fixed-rate regimes, in Japan during 1973-75, the Philippines during 1970-71, and Korea in 1970-72 and 1975-77.

This informal survey of inflation experiences indicates that domestic inflation in the four countries might have been lower had they adopted optimal exchange-rate policies.

Finally, several caveats are in order. First, it should be borne in mind that the "optimality" of exchange-rate policy is defined in this paper solely in terms of reducing domestic inflation in the face of internal and external disturbances. As important as that objective may be, policymakers might well have other objectives in mind, e.g., domestic income stabilization and economic growth. Hence, although a less-than-optimal exchange-rate policy in the present context means a higher domestic inflation rate than otherwise, it does not necessarily imply a wrong policy. Second, the recommendation for resisting depreciation as an anti-inflation policy is predicated on the assumption that the exchange-market pressure is transitory, or that appropriate adjustment mechanisms can work rapidly enough to restore balance in the nation's international payments before its foreign reserves or foreign-credit facilities are seriously depleted. Specifically, it is not an endorsement of a pegged exchange rate under continuing domestic inflation, with the exchange rate sustained by extensive trade and exchange restrictions. Third, the assumption of a "small open economy," defined in the next section, should be underscored. This implies that foreign repercussions of the country's policy actions can be ignored. The analysis is particularly inapplicable to large economies such as the United States, whose economic activities significantly affect the rest of the world.

I. Framework of Analysis

The analytical framework presented in this paper is one familiar in the literature on policy choice for maintaining internal and external balance. This approach, pioneered by Robert Mundell, Marcus Fleming and others, is simplified here by assuming full-employment output and no bond market, so as to focus on the relationship between the exchange rate and the domestic price level.[4] Those who are not interested in formal economic analysis may skip to the next section, where the analytical results are summarized.

We also assume in this analysis that the country is a price taker in the world market for both its exports and its imports. That is to say, it possesses no monopolistic power over its exports and no monopsonistic power over its imports, so that the world demand for its exports and the supply of its imports are both perfectly elastic. Moreover, terms-of-trade changes are ignored, so that the country's exports and imports are regarded as one good, a "tradable good," in distinction to another good, the "nontradable good."

Both the tradable good and the nontradable good are produced and consumed by the residents of the country. The production of each good is assumed to depend only on the relative prices of the two, while the demand depends on real income, relative prices, and real money balances. The price of the nontradable good is determined by the domestic demand and supply conditions in that market. The price of the tradable good, on the other hand, is equal to its given foreign price multiplied by the exchange rate, which is defined as the price of the foreign currency in terms of the national currency. Under flexible rates, the exchange rate is determined by supply and demand in the foreign-exchange market, which in turn depends on the

nation's trade balance and exogenously-given net capital flows. Under fixed exchange rates, the exchange rate is by definition set by the monetary authorities through exchange-market interventions, with resultant changes in the central bank's foreign reserves and the domestic money supply.

Finally, in order to simplify the analysis, we assume that both consumers and producers are devoid of "money illusion"; that is to say, the demand and supply of each good are dependent only on real magnitudes and relative prices, so that proportionate changes in all prices and the money supply would leave both demand and supply unaffected.[5] This money-neutrality assumption, which is standard in neo-classical economic theory, insures the same proportionality of all price changes as a given change in the money supply.[6]

Consider now various sources of inflation, and compare how the aggregate price level—defined as a weighted average of the two commodity prices—would be affected under fixed and flexible exchange rates. Four types of disturbances may be distinguished: foreign price increases, domestic credit expansion, autonomous changes in domestic demand or supply in the two goods markets, and net international capital flows. Obviously, these four types cover a very large variety of disturbances which can be sources of inflation in a country open to international trade and capital flows.

The four types of disturbances affect the domestic price level through their effects on the demand and supply of tradable and nontradable goods. Three types of impacts are considered in this model: a "relative price effect," a "real balance effect," and a "real income effect." The first refers to the response of the domestic demand and supply of the two goods to a change in their relative prices: the quantity supplied is postulated to rise, and the quantity demanded to fall, with a rise in the price of the good relative to that of the other good. In addition, the model assumes that demand is positively related to both real income and the real money balance held by the public—the latter being defined as the nominal money supply adjusted for changes in the domestic price level—such that an increase in either will increase the demand for both goods. The stability of the two-sector model requires that the marginal propensity to spend on either good (the real income effect) be less than unity, and that the real-balance effect on demand of a price change in one sector be algebraically smaller than the sum of its relative-price effects on both the demand and the supply in that sector. Finally, the model assumes that changes in the nominal money supply are determined partly by changes in the central bank's foreign reserves and partly by domestic credit expansions or contractions.

World Price Increase. Under a fixed exchange rate, the domestic price of the tradable good will rise in proportion to the rise in its world price. Through the relative-price effect, which by assumption outweighs the real-balance effect, the domestic output of the tradable good will rise and the demand for it fall, resulting in an improvement in the nation's trade balance, an increase in its reserves, and domestic monetary expansion. The monetary expansion, through the real-balance effect, implies an increase in the demand for both goods, thus raising the price of the nontradable good and reducing the trade surplus. Final equilibrium will be attained in both markets when both prices have risen proportionately to restore the same relative prices as at the initial equilibrium, and the trade surplus is completely eliminated.

Under flexible exchange rates, on the other hand, a world price increase will result in an appreciation of the national currency in proportion to the world price increase, thus leaving the domestic price of the tradable good unchanged. There is neither a relative-price effect nor a real-balance effect. Hence, there is no change in the domestic price level.

Thus, a fixed exchange rate exposes a country to inflation pressures from abroad, while upward flexibility of the exchange rate insulates the domestic price level from such pressures. In both cases, the world inflation pressures are manifested in the foreign-exchange market—in the form of a reserve accumulation in the fixed-rate case and of exchange-rate appreciation in the flexible-rate case.

Domestic Credit Expansion. Domestic credit expansion will result in an increase in the money supply and, through the real-balance effect, in an

increase in domestic demand in both tradable-good and nontradable-good markets. Under a fixed exchange rate, only the nontradable-good price will rise, as the price of the tradable good is fixed by its world price and the pegged exchange rate. As relative prices change, the supply of the tradable good will fall and its demand rise, thus bringing about a trade deficit and hence a decline in foreign reserves and in the domestic money supply. Through the real-balance effect, demand will fall back in both markets, until the nontradable-good price returns to its original level and the trade deficit is eliminated. Full equilibrium will be restored when the two prices and the money supply all fall back to their respective initial levels. In the end, the only consequence of the domestic credit expansion is an exchange of domestic assets for foreign assets in the central bank's portfolio, with no net effect on either absolute or relative prices, domestic output or expenditures.

Under a flexible exchange rate, on the other hand, whenever domestic credit expansion brings about an increase in the money supply, the real-balance effect will raise domestic demand in both tradable-good and nontradable-good markets, as in the fixed-rate case. However, because the exchange rate can now fluctuate, the prices of both goods are flexible, so that under domestic demand pressure the prices of both goods will rise. Full equilibrium will be restored when prices have risen in proportion to the increase in the money supply, in accordance with the money-neutrality assumption.

Thus, when a domestic credit expansion creates inflation pressure, a fixed exchange rate relieves that pressure through a trade deficit—and also sets off an adjustment mechanism, through reserve depletion and monetary contraction, which reduces both the inflation pressure and the trade deficit. A flexible exchange rate, on the other hand, through exchange depreciation, seals up the inflation pressure at home, so that the full strength of that pressure is exerted on the domestic price level, as in a closed economy. Again, in both cases, the inflation pressure is manifested in the foreign-exchange market—reserve drain in the fixed-rate case and exchange depreciation in the flexible-rate case.

Autonomous Demand or Supply Changes. Disturbances of this type can occur in either of the two goods markets. Instead of analyzing all such cases, we shall consider only the case of a supply increase—say, due to successful adoption of advanced technology—in the tradable-good sector, and briefly summarize all the other possibilities.

Under a fixed exchange rate, an output expansion in the tradable-good sector will result in an improvement in the nation's trade balance, an accumulation of reserves, and a monetary expansion, with no effect on the domestic price of the tradable good. However, because of the higher real income and the induced monetary expansion, domestic demand for both goods will rise, leading to a rise in the price of the nontradable good and a reduction in the trade surplus. Full equilibrium will be restored when the nontradable-good price has risen sufficiently for the relative price-effect to completely offset the combined real-income and real-balance effects, and when the trade surplus is completely eliminated. In the end, the domestic price level will be higher than at the initial equilibrium.

Under a flexible rate, on the other hand, output expansion in the tradable-good sector will lead instead to an appreciation of the national currency and a consequent reduction in the domestic price of the tradable good, with no effect on the trade balance and the money supply. Through the relative-price effect, which by assumption must be greater than the real-balance effect, supply will rise and demand will fall in the nontradable-good sector, but demand for the nontradable good will rise because of the real-income effect arising from the output expansion. The net effect on the price of the nontradable-good is indeterminate. But regardless of the effect on the nontradable-good price, the aggregate price level will definitely be lower than at the initial equilibrium.[7]

Thus, a supply increase in the tradable sector results in a rise in the price level under a fixed exchange rate but a decline under a flexible rate. These different results arise because the disturbance leads to a reserve accumulation in the fixed-rate case and to exchange appreciation in the flexible-rate case. Again, the form in which the disturbance manifests itself in the foreign-exchange market, as determined by the

exchange-rate policy, makes a critical difference in its impact on the domestic price level.

Without going through the analysis, we shall merely note that a supply increase in the nontradable sector will result in a decline in the domestic price level under both a fixed and a flexible exchange rate. The decline will be smaller under the former than under the latter, the difference again being due to the resultant reserve accumulation (hence monetary expansion) in the fixed-rate case and to exchange appreciation in the flexible-rate case. Moreover, as would be expected, the results of supply decreases are symmetrical (i.e., of opposite signs) to those of supply increases, and those of demand changes symmetrical to those of corresponding supply changes.

Capital Flows. Capital flows affect the domestic price level indirectly through their impact on the exchange rate or on foreign reserves. Under a flexible rate, a net capital outflow will result in a depreciation of the national currency, thus directly raising the price of the tradable good and indirectly raising that of the nontradable good through the relative-price effect. The domestic price level will definitely be higher. Under a fixed rate, on the other hand, the capital outflow will result in a reserve loss, monetary contraction, and (through the real-balance effect) in a reduction in demand for both goods. At the final equilibrium, the domestic price level will be lower than at the initial equilibrium. A net capital inflow will have exactly the opposite results. Again, the exchange-rate policy makes a critical difference in the response of the domestic price level to the given disturbance, depending on whether the exchange-market pressure is manifested in exchange-rate adjustments or in reserve changes.

II. Analytical Results

So far, we have examined the impact on the domestic price level of four types of disturbances: foreign price increases, domestic credit expansions, domestic demand or supply shocks, and international capital flows. A large number of cases have been analyzed, because in reality inflation can be attributed to a variety of causes. Our purpose is to construct a model that can analyze the impact on the domestic price level of all such disturbances, and see if any generalization could be derived from the results that might be useful to policymakers. The results are summarized in Figure 1.

Figure 1
Impact of Disturbances on Domestic Price Level

	Fixed Exchange Rates		Flexible Exchange Rates	
Type of Disturbance	**Reserve Change**	**Price Level**	**Exchange Rate**	**Price Level**
Foreign price increase	Increase	+	Appreciation	0
Credit expansion	Decrease	0	Depreciation	+
Domestic supply changes				
Expansion, tradable good	Increase	+	Appreciation	–
Expansion, nontradable good	Increase	–	Appreciation	––
Contraction, tradable good	Decrease	–	Depreciation	+
Contraction, nontradable good	Decrease	+	Depreciation	++
Capital flows				
Net outflow	Decrease	–	Depreciation	+
Net inflow	Increase	+	Appreciation	–

Symbols:
"0" denotes no change in the domestic price level.
"+" denotes a rise in the domestic price level.
"++" denotes a larger rise in the domestic price level than would occur under the fixed-rate case.
"–" denotes a fall in the domestic price level.
"––" denotes a larger fall in the domestic price level than would occur under the fixed-rate case.

In an open economy, as shown in Figure 1, any disturbance to the economy is always reflected in the foreign-exchange market, either as a reserve change under fixed exchange rates or as an exchange-rate adjustment under flexible exchange rates. Moreover, the various types of disturbances may result in either an *upward* exchange-market pressure on the national currency (i.e. a reserve increase or an exchange appreciation) or a *downward* pressure (i.e. a reserve decrease or an exchange depreciation). Where the exchange-market pressure is upward—as in the case of a foreign-price increase, an expansion in domestic supply of either good, or a net capital inflow—a flexible-rate policy permitting appreciation would in every case result in a smaller price increase or a larger price decline than would occur under a fixed-rate policy. Conversely, where the market pressure is downward—as in the case of a domestic credit expansion, a contraction in domestic supply in either market, or a net capital outflow—a fixed-rate policy drawing down reserves would in every case lead to a smaller price rise or a larger price decline than would occur under a flexible-rate policy. Thus, an exchange-rate policy designed to minimize domestic price inflation should *permit exchange appreciation and resist depreciation,* regardless of the source of inflation.

The rationale behind this policy rule can be better understood by considering the relationship between the exchange-market pressure and changes in the domestic price level. The foreign-exchange market is like a set of valves adjusting the reciprocal excess demand or supply of national currencies through changes in their exchange rates. An upward pressure signals an excess demand for the national currencies by the holders of foreign currencies, because of their desire to acquire the goods, services, and financial assets denominated in the nation's currency. (For brevity, call it the "foreign" excess demand, even though it refers to that of the holders of foreign currencies, be they domestic or foreign residents.) A fixed-exchange-rate policy would keep the adjustment valves wide open, thus allowing the foreign excess demand to spill fully into the domestic market and raise the domestic price level. A flexible-rate policy, on the other hand, would shut off the valves by making the national currency dearer in terms of foreign currencies, thereby discouraging the foreign excess demand from the national market. Under these circumstances, a flexible-rate policy permitting exchange appreciation is clearly to be preferred.

A downward pressure, on the other hand, signals an excess demand for foreign currencies by the holders of the national currency, because of their desire to acquire goods, services, and financial assets denominated in foreign currencies. (Term it the "domestic" excess demand.) A flexible-rate policy would again turn off the valves by making the foreign currencies dearer in terms of the national currency. This would shut in the domestic excess demand and compel it to apply all its pressure on the domestic price level. A fixed-rate policy, on the other hand, would call for the central bank to draw down foreign reserves so as to satisfy the domestic excess demand for foreign currencies. This would keep the valves open and thus would channel the domestic inflation pressure toward foreign goods, services and financial assets, and away from the domestic market. In the process, the central bank would reduce the amount of the national currency in the public's holdings, and thus erode the basis of the excess demand for foreign currencies. Under such circumstances, a fixed-rate policy would help reduce the domestic inflation pressure.

This interpretation helps bring out several implications of the proposed exchange-rate policy. First, the policy rule means a deliberate attempt to shield the nation from foreign inflation pressures and to direct domestic inflation pressures toward the rest of the world. Obviously, this asymmetrical policy can be operative only for those nations that do not have to worry about repercussions from the rest of the world. Foreign countries, for instance, might react by appreciating their currencies against the nation's currency, in effect sealing the inflation pressure within the nation from which it originates. Alternatively, where the inflating nation depends on foreign borrowings to finance its deficits, the foreign lenders could progressively make their terms of lending more onerous. As for the second implication, the proposed downward exchange-rate rigidity presumes ample reserves in relation to

the reserve drain, as well as an effective adjustment process for reducing the reserve drain. The policy is merely a short-run stop-gap measure. Impeding the adjustment process by continued domestic monetary expansion, for instance, would ultimately destroy its usefulness.

III. Experiences of Pacific Basin Countries

With this policy rule in hand, we now turn to examining the inflation and exchange-rate experiences of four Pacific Basin countries—Japan, Korea, the Philippines, and Taiwan—during the 1968-78 period. We assess the appropriateness of their policies from the viewpoint of minimizing domestic inflation, to see if the policy rule can help interpret actual events in the period studied. The data for the four countries are selected on the basis of the economic analysis presented above (Tables 1-4 and Charts 1-2).

Japan

The Japanese yen was at first pegged to the U.S. dollar, drifted up after August 1971, and then officially floated in February 1973. After that, it fell during the oil crisis and world recession of 1974-75, and then rose sharply in 1976-78.

During the fixed-rate period of 1968-70, the exchange-market pressure was relatively mild. The overall balance-of-payments surplus averaged a relatively small $1 billion a year. During 1971-72, the payments surplus leaped to an average of $6.7 billion a year, in spite of the 18-percent yen appreciation from 1970 to 1972. The Bank of Japan responded to this strong upward pressure with a combination of exchange-market interventions and exchange-rate adjustments. As a result of the market interventions, the annual money-growth rate rose from an average of 17 percent in 1968-70 to an average of 27 percent in 1971-72 (Chart 2). As shown in the central bank's balance sheet (Table 1), the 1971-72 increase in total assets, amounting to ¥2.8 trillion, was more than explained by a rise of ¥3.9 trillion in its foreign-asset holdings. Given the lag between monetary expansion and price increases[8], the high money-growth rate of 1971-72 set the stage for the double-digit price inflation in 1973-74. The 1973-74 inflation thus can be traced, at least in part, to the 1971-72 exchange-rate policy.[9]

Under heavy exchange-market pressure, the yen officially floated in February 1973 and appreciated by 12 percent on a year-to-year average basis. However, during 1973 the

Table 1
Japan: Inflation, Exchange Rates, Balance of Payments and Money, 1968-78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Inflation Rate[1]	4.4	6.0	7.8	5.4	4.5	16.5	24.5	8.5	9.4	6.2	3.4
Exchange Rate[2]	99.5	100.1	100.1	103.0	118.3	132.2	123.0	120.8	120.9	133.6	170.4
Balance of Payments[3]											
Current Account	1.0	2.1	2.0	5.8	6.6	–0.1	–4.7	–0.7	3.7	10.9	17.5
Capital Account	–0.2	–1.4	–0.8	4.6	–3.6	–6.2	5.9	0.1	0.1	–4.4	–7.5
Money Growth Rate[4]	13.4	20.6	16.8	29.7	24.7	16.8	11.5	11.1	12.5	8.2	13.4
Central Bank Assets[5]											
Total	0.91	0.92	1.08	0.25	2.51	2.04	2.44	1.57	1.19	2.24	n.a.
Foreign Assets	0.32	0.27	0.43	3.03	0.89	–1.89	0.39	–0.22	1.17	1.94	n.a.
Claims on Government	0.48	0.32	0.33	–1.16	–0.54	0.47	2.48	3.56	–0.33	–0.47	1.77
Claims on Banks	0.12	0.33	0.32	–1.62	2.17	3.45	–0.44	–1.77	0.35	0.77	0.27

1 Percentage change in consumer-price index, fourth quarter to fourth quarter.
2 Exchange rate vs. U.S. dollar, annual average, June 1970=100.
3 Balance on current and capital accounts, in billions of U.S. dollars.
4 Percentage change in M_1 (currency plus bank demand deposits), year end to year end.
5 Change in assets, in trillions of yen, year end to year end.
Source: International Monetary Fund, *International Financial Statistics,* various issues.

exchange-market pressure reversed its direction, as the current-account balance turned into a small deficit, and a large net capital outflow occurred. The Bank of Japan intervened heavily to support the yen, so that its foreign-exchange holdings fell from $16.5 billion to $10.2 billion between year-end 1972 and year-end 1973, while the money-growth rate dropped from 25 percent to 17 percent between 1972 and 1973. The central bank's total assets rose by ¥2.0 trillion, while foreign assets declined by ¥1.9 trillion. The exchange-market interventions played a significant role in reducing money growth in 1973, and thus contributed to the reduction of inflation pressures in subsequent years.

The yen continued to decline in 1974 and 1975. The Bank of Japan persisted in its policy of reducing the money-growth rate, bringing it

Chart 1

Exchange Rate Pressures

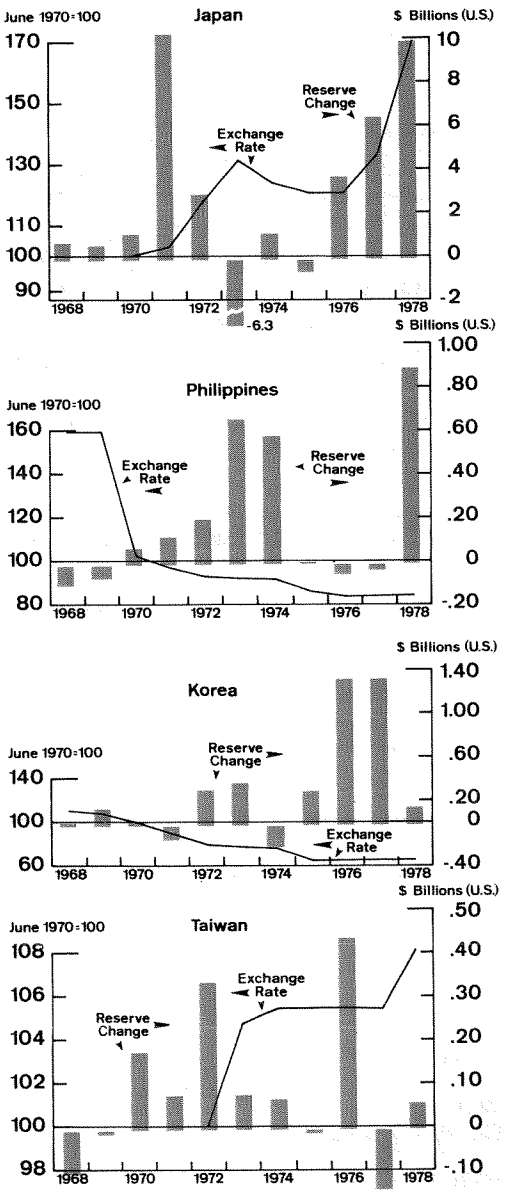
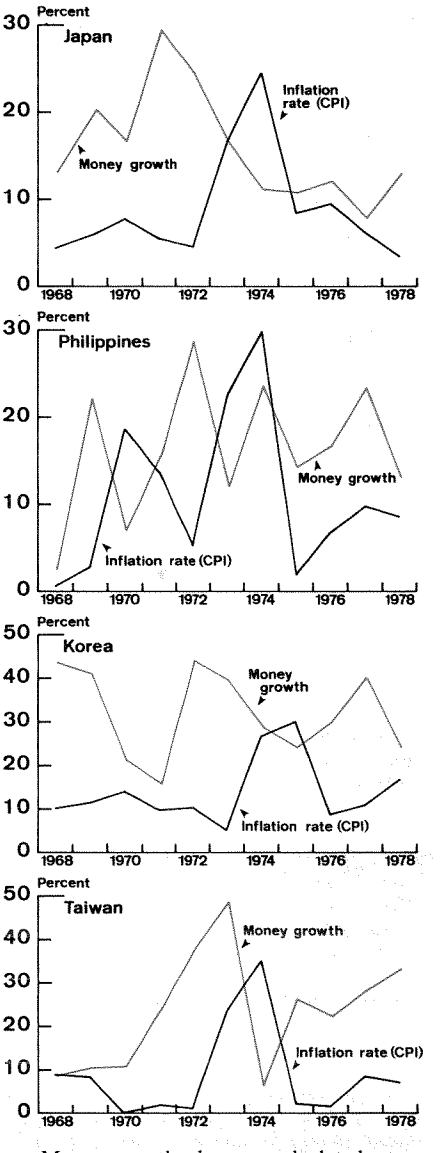


Chart 2

Money-Growth and Inflation Rates



Note: Money-growth changes calculated on a year-end to year-end basis, and inflation rates on a fourth-quarter to fourth-quarter basis.

down further to 11 percent in 1975. The inflation rate finally came down from 24 percent in 1974 to 8 percent in 1975. However, exchange-rate policy apparently contributed little to anti-inflation policy during this period, with little central-bank intervention to moderate the yen depreciation.

From 1975 to 1978, the situation again changed as the yen came under heavy upward pressure in the exchange market. Japan's current-account balance swung from a deficit of $0.7 billion in 1975 to a surplus of $17.5 billion in 1978. Again, the Bank of Japan adopted a "leaning against the wind" policy of attempting to moderate the yen's appreciation by heavy exchange-market interventions. In 1977-78, while the yen appreciated by 40 percent, the Bank of Japan added $16.5 billion to its foreign reserves. Although this action went against our exchange-rate policy rule, the Bank of Japan was able to hold the money-growth rate at 11 percent during the 1977-78 period—about the same as during 1974-76, but only about half the rate of the 1971-73 period. As a result, the inflation rate dropped precipitously from 25 percent in 1974 to only 3 percent in 1978.

To summarize, Japan's 40-percent exchange appreciation during 1977-78 was in accordance with our exchange-rate policy rule and probably contributed significantly to the reduction in Japan's inflation rate. In addition, heavy exchange-market interventions allowed foreign excess demand to affect domestic markets, but the Bank of Japan—through a tight monetary policy—was able to offset both the direct market impact and the secondary monetary impact. This experience suggests that our policy rule is by no means absolute. Other policy measures, such as a steady application of tight monetary policy, can bring inflation under control with little assistance from this source.

The Philippines

After sustaining a deteriorating payments deficit since 1967, the Philippines abandoned fixed exchange rates in February 1970—at which point the peso depreciated 39 percent over a seven-month period. Since September 1970, the Philippine Bankers Association has set a daily "guiding rate" for all foreign-exchange transactions, and the central bank has intervened to keep the peso-dollar rate within the range set by the Association. Nominally, the daily guiding rate is free to float, but in fact it has remained stable and has been adjusted from time to time only in small steps. For practical purposes, the

Table 2
Philippines: Inflation, Exchange Rates, Balance of Payments and Money, 1968-78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Inflation Rate[1]	0.5	2.8	18.7	13.6	5.2	22.6	29.8	1.8	6.7	9.7	8.6
Exchange Rate[2]	159.3	159.3	102.4	96.4	92.7	91.8	91.4	85.4	83.4	83.8	84.2
Balance of Payments[3]											
Current Account	-0.27	-0.25	-0.05	0.00	0.01	0.48	-0.21	-0.92	-1.10	-0.83	-1.22
Capital Account	0.18	0.19	0.13	0.13	0.20	0.19	0.80	0.93	1.05	0.80	2.12
Money Growth Rate[4]	2.9	22.5	7.3	16.3	29.1	12.3	24.0	14.5	17.1	23.7	13.4
Central Bank Assets[5]											
Total	0.3	0.5	0.7	0.7	2.1	4.0	6.2	3.2	2.0	-1.0	8.3
Foreign Assets	-0.1	-0.2	0.7	0.6	1.0	4.3	3.6	-0.4	2.3	-0.7	2.7
Claims on Government	0.2	0.5	0.3	0.1	0.8	0.3	1.1	-1.1	0.9	0.7	1.5
Claims on Banks	0.2	0.2	-0.3	0.0	0.3	-0.6	1.5	4.7	-1.2	-1.0	4.1

1 Percentage change in consumer-price index, fourth quarter to fourth quarter.
2 Exchange rate vs. U.S. dollar, annual average, June 1970=100.
3 Balance on current and capital accounts, in billions of U.S. dollars.
4 Percentage change in M_1 (currency plus bank demand deposits), year end to year end.
5 Change in assets, in billions of pesos, year end to year end.
Source: International Monetary Fund, *International Financial Statistics*, various issues.

peso/dollar rate remained unchanged from 1975 to 1978 (Chart 1).

After the 1970 devaluation, exchange-market pressures turned upward on the peso. In 1971 and 1972, the current-account deficits of past years were eliminated, while net capital inflows continued. Aided by a world commodity boom, the current-account balance showed a substantial surplus of $480 million in 1973. In the following year, the world oil crisis turned it into a deficit of $210 million, but the deficit was more than offset by a $800 million net capital inflow. All this would have led one to expect an appreciation of the peso from 1970 to 1974; in fact, it depreciated by 11 percent. The explanation lies in the central bank's foreign-exchange purchases, which raised its foreign-exchange reserves from $200 million at the end of 1970 to $1.4 billion at the end of 1974.[10]

This policy of achieving currency depreciation in the face of upward exchange-market pressures is, of course, exactly opposite to what our policy rule would suggest for reducing domestic inflation. The central bank did not try to use currency appreciation to discourage foreign excess demand from spilling into the domestic market, but rather encouraged this process through deliberate depreciation. Consequently, the money-growth rate increased from 11 percent in 1968-70 to 20 percent in 1971-74 (Chart 2). The central bank's balance sheet shows that 73 percent of the increase in its total assets during the 1971-74 period was due to foreign-asset accumulation. Thus, the central bank's exchange-rate policy apparently aggravated the rapid monetary growth in 1971-74 and was at least partly responsible for the high inflation rate—averaging 26 percent a year—in 1973-74.

This policy of deliberate depreciation was abandoned after 1974. As the current-account balance deteriorated to an average deficit of about $1 billion a year in 1975-78, the peso was kept stable largely through heavy foreign borrowings. Although the money-growth rate remained as high as 17 percent, the inflation rate declined sharply to an average annual rate of 7.5 percent from 30 percent in 1974. Since apart from foreign borrowings, the exchange-market pressure during the period was clearly downward, the nation's exchange-rate policy of resisting depreciation agreed well with our policy rule. But there was one important exception: Foreign borrowings enabled the central bank to add to its reserves, and thus thwarted the adjustment process for restoring balance-of-payments equilibrium through reserve depletion and monetary contraction, as envisaged in our model. Prolonged continuation of this policy could exacerbate inflation pressure in the Philippines.

Korea

Korea maintained a flexible exchange rate from March 1965 to August 1972, with the won-dollar exchange rate being set daily by a group of designated government-owned exchange banks. But between August 1972 and December 1974, Korea maintained the won at a fixed rate of W400 to the dollar, and then devalued to W484 (Chart 1).

From 1968 to 1971, the exchange-market pressure was downward on the won, as the currency depreciated steadily with little official intervention, except for a period in 1971 when the Bank of Korea attempted to slow the rate of depreciation. The source of the exchange-market pressure was an upsurge in monetary growth (32 percent a year) due to domestic credit expansion.

Surprisingly, the central bank's asset portfolio showed significant increases in foreign-asset holdings during this period (Table 3). However, since Korea's major banks were all government-owned, the distribution of foreign assets between the central bank and the commercial banks was not as meaningful as it would have been in other countries. From an examination of the balance sheet of the consolidated banking system, it becomes clear that the banking system's foreign assets actually declined during the period, and that all of the rapid monetary growth was due to banking credits extended to the domestic sector.

Apparently, Korea's authorities pursued a policy of liberal credit expansion to finance domestic economic development, and coupled this with a flexible exchange rate to free the authorities from balance-of-payments concerns. The policy succeeded in providing the country with a 10-percent annual average growth rate of real output during those years. However, it also led to an 11-percent inflation rate during the 1968-71 period—the highest among all four countries during that period (Chart 2).

Korea abandoned the floating exchange rate in 1972, and accompanied this move with strict price controls. The nominal consumer-price index rose only 5 percent in 1973. Moreover, as a result of vigorous export growth, the current-account deficit dropped sharply from $850 million in 1971 to an average of only $340 million in 1972-73, while net capital inflows continued at the rate of $700 million a year. The resultant reserve increases added directly to domestic money growth and indirectly also encouraged an acceleration of domestic credit expansion (Table 3). The result was a 43-percent annual money-growth rate in 1972-73, compared to 19 percent in 1970-71. The way was thus paved for a steep price rise, averaging 28 percent a year, in 1974-75. Since the increase in foreign assets accounted for about one-fourth of the banking system's total credit expansion of the 1972-73 period, it appears reasonable that that period's exchange-rate policy contributed significantly to the subsequent rapid inflation.

The 21-percent devaluation of the won in December 1974 was a reaction to the sharp deterioration in Korea's current account as a result of the oil-price increase and world recession. The move was perhaps inevitable in view of Korea's exceedingly slender foreign reserves[11] and its continued domestic credit expansion. Nevertheless, inflation might have been lower in 1975 had Korea been able to resist devaluation through, for instance, larger foreign borrowings.

Aside from its inflation effect, the devaluation helped set the stage for a remarkable strengthening of Korea's international-payments situation.[12] While foreign borrowing continued at a high rate, the current account improved dramatically from an annual average deficit of $2.0 billion in 1974-75 to a small surplus in 1977. With the exchange rate fixed against upward exchange-market pressure, the central bank's foreign assets rose rapidly in 1976 and 1977, and this accounted for 70 percent of the central bank's asset increase and 35 percent of the consolidated banking system's total credit extension in those years. Meanwhile, the money-growth rate rose from 25 percent in 1975 to 41 percent in 1977. The fixed-exchange-rate policy under mounting upward exchange-market pressure was clearly incompatible with domestic

Table 3
Korea: Inflation, Exchange Rates, Balance of Payments and Money, 1968-78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Inflation Rate[1]	10.2	11.4	13.9	9.7	10.3	5.1	26.6	30.0	8.7	10.8	16.8
Exchange Rate[2]	111.8	107.2	99.5	88.2	78.6	77.7	76.3	64.0	64.0	64.0	64.0
Balance of Payments[3]											
Current Account	-0.44	-0.55	-0.62	-0.85	-0.37	-0.31	-2.03	-1.89	-0.30	0.01	-1.09
Capital Account	0.48	0.71	0.68	0.71	0.70	0.70	1.81	2.21	1.65	1.35	1.25
Money Growth Rate[4]	44.5	41.8	22.1	16.4	45.1	40.6	29.5	25.0	30.7	40.7	24.9
Central Bank Assets[5]											
Total	42	71	80	-5	195	265	393.7	646.3	686.3	959.1	736.7
Foreign Assets	36	44	22	-24	-16	136	-163.9	264.7	560.4	586.3	-200.1
Claims on Gov't	-1	11	3	-3	144	28	171.1	362.0	125.6	210.7	292.0
Claims on Banks	7	16	55	22	68	101	386.5	19.6	0.3	162.1	644.8
Banking System Assets[5]											
Total	213	304	216	206	428	671	674	939	1389	1852	2584
Foreign Assets (Net)	5	22	5	-71	68	197	-417	-57	475	666	-254
Domestic Credit	208	282	211	277	360	474	1091	996	914	1186	2838

1 Percentage change in consumer-price index, fourth quarter to fourth quarter.
2 Exchange rate vs. U.S. dollar, annual average, June 1970=100.
3 Balance on current and capital accounts, in billions of U.S. dollars
4 Percentage change in M_1 (currency plus bank demand deposits), year end to year end.
5 Change in assets, in billions of NT dollars, year end to year end.
Source: International Monetary Fund, *International Financial Statistics,* various issues.

monetary stability. The inflation rate thus rose from 8 percent in 1976 to 17 percent in 1978.

Under these circumstances, our policy rule would call for currency appreciation to relieve the inflation pressure. Korea, however, took a different route. Instead of currency appreciation, it chose the path of trade liberalization to reduce its payments surplus, with such measures as tariff reductions, abolishment of import quotas, and official foreign purchases. These measures have led to a shift in the nation's current account, resulting in a $1.1-billion deficit in 1978. Moreover, from the viewpoint of long-run economic growth, the trade-liberalization measures should stimulate improvement in productive efficiency through enhanced competition. However, greater productive efficiency in the Korean context is likely to mean an accelerated export-growth rate. Unless import growth can keep pace, sooner or later Korea may have to face up to the need for an appropriate exchange-rate policy to reduce its very high domestic inflation rate.

Taiwan

Among the countries examined, Taiwan was the most successful in maintaining domestic price stability during the 1968-78 period. Except for the 1973-74 period, the consumer inflation rate averaged 4.5 percent a year during the period, compared to 6.2 percent for Japan, 7.5 percent for the Philippines, and 10.8 percent for Korea (Chart 2).

Taiwan was also the only country among the four that consistently maintained a fixed exchange-rate policy. Throughout the eleven-year period, the New Taiwan dollar (NT) was pegged to the U.S. dollar—except for a revaluation from NT40 to NT 38 in February 1973, and another revaluation to NT36 in July 1978 (Chart 1). The 1978 revaluation was accompanied by a decision to float the currency, which was put into effect on February 1, 1979, thus officially abandoning the long-standing fixed-rate policy.

Taiwan's exchange-rate policy presents another example of the difficulty of maintaining a fixed exchange rate under mounting upward exchange-market pressure. Since 1968, the country's current account improved steadily because of a rising export surplus, except for a major break in trend that occurred during the oil crisis and world recession of 1974-75.

Table 4
Taiwan: Inflation, Exchange Rates, Balance of Payments and Money, 1968-78

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Inflation Rate[1]	8.9	8.5	0.1	1.9	1.6	23.6	34.8	2.2	1.5	8.4	7.1
Exchange Rate[2]	100	100	100	100	100	104.7	105.4	105.4	105.4	105.4	108.1
Balance of Payments[3]											
Current Account	-0.12	-0.03	0.0	0.18	0.52	0.57	-1.11	-0.59	0.32	0.98	1.74
Capital Account	0.01	0.01	0.18	-0.10	-0.18	-0.49	1.18	0.58	0.12	-1.12	-1.68
Money Growth Rate[4]	9.4	11.1	11.4	24.6	37.9	49.3	7.0	26.9	23.1	29.1	34.1
Central Bank Assets[5]											
Total	4.0	3.8	8.9	6.2	24.2	25.7	29.7	20.3	44.6	52.2	77.9
Foreign Assets	0.7	5.9	8.8	6.7	23.9	-2.5	0.7	10.1	19.1	-6.0	0.8
Claims on Gov't	1.0	-0.4	0.3	-2.4	-0.2	1.9	5.3	-2.0	3.1	-2.0	-1.4
Claims on Banks	2.3	-1.7	-0.2	1.9	0.5	26.3	23.7	12.2	22.4	60.2	78.5
Banking Assets[5]											
Total	6.9	12.8	21.0	27.9	45.8	64.3	61.9	74.0	94.5	148.2	196.6
Foreign Assets (Net)	-1.3	2.6	8.6	5.7	24.5	21.4	-21.6	-6.9	38.4	45.9	69.5
Domestic Credit	8.2	10.2	12.4	22.2	21.3	42.9	83.5	80.8	56.0	102.3	127.1

1 Percentage change in consumer-price index, fourth quarter to fourth quarter.
2 Exchange rate vs. U.S. dollar, annual average, June 1970=100.
3 Balance on current and capital accounts, in billions of U.S. dollars.
4 Percentage change in M_1 (currency plus bank demand deposits), year end to year end.
5 Change in assets, in billions of won, year end to year end.
Source: International Monetary Fund, *International Financial Statistics,* various issues.

In addition, there were steady net capital inflows, although that is not obvious from the published balance-of-payments data. As in Korea, Taiwan's major commercial banks are government-owned and operate under the central bank's direction. At times (e.g., 1973 and 1977), the central bank reduced its foreign-asset holdings, but the commercial banks increased their holdings by much larger amounts. These increases by convention are considered as private capital outflows, so that published balance-of-payments data show a substantial net capital outflow in both years (Table 4). However, the data are misleading since the balance sheet of the consolidated banking system shows large increases in the banking system's foreign assets in both years.

Thus, from 1968 to 1973, Taiwan attempted to maintain a fixed exchange rate under mounting upward exchange-market pressure. At first, the pressure was relatively small, so that the money supply increased at 10.5 percent a year during 1968-70—remarkably low considering that real output increased almost as fast during that period. The relatively low money-growth rate of 1968-70 helps to account for the sustained low inflation rate, averaging 1.2 percent a year, during 1970-72 (Chart 2). However, from 1970 on, the money-growth rate accelerated steadily and steeply to reach 49 percent a year in 1973. During the four years 1970-73, foreign assets accounted for 38 percent of the total credits extended by the consolidated banking system; even more remarkably, from 1969 to 1972, foreign assets accounted for more than the total credits extended by the central bank. After considerable lag, the accelerating money growth finally hit the economy, and the consumer price index jumped 24 percent in 1973. The 1973 revaluation of 5.3 percent was apparently too small to be effectual, as foreign assets continued to accumulate in the banking system and money growth continued to accelerate throughout that year.

The oil shock and the world recession in 1974-75 saved Taiwan from the need for further currency revaluations, by bringing to an end the steady string of current-account surpluses. The $1.1 billion current-account deficit in 1974 helped the money-growth rate to drop precipitously from 49 percent in 1973 to only 7 percent in 1974. But the rapid money growth of prior years continued to exert its toll, as the inflation rate rose to 35 percent in 1974. Nevertheless, the monetary contraction of 1974 helped bring about a sharp deceleration in inflation, with the inflation rate declining to only 2.2 percent a year in 1975.

But with the subsequent world economic recovery, Taiwan resumed its steady export growth, so that its current account swung from a deficit of $0.6 billion in 1975 to a $1.7-billion surplus in 1978. As reserve accumulation resumed and the money-growth rate accelerated to 23 percent in 1978, the stage was set for a re-run of the scenario that had precipitated the currency revaluation of February 1973

In July 1978, the central bank again responded with a small currency appreciation of 5.5 percent, but this time also announced a decision to abandon the fixed rate. The decision was officially implemented on February 1, 1979, although *de facto* changes in the exchange rate have since been very small. A replay of the earlier story remained a distinct possibility, until the 1979 oil-price increases again disrupted the upward trend in the current-account surplus.

IV. Conclusion

The exchange-rate and inflation experiences of the four Pacific Basin countries during the 1968-78 period provide a wide range of cases for testing the validity and relevance of the model presented in this paper. Even though we have not attempted a formal statistical testing, we have obtained several useful insights from this survey.

First, in a number of episodes, exchange-rate policies affected domestic price levels in an important way. In particular, all four countries experienced rapid monetary growth during 1971-73—the exact years varying from country to country—as a result of their resistance to currency appreciation during a period of strong upward exchange-market pressures. In all cases except Korea, reserve accumulation apparently

accounted for most of the rapid monetary growth. (Korea's monetary growth was dominated by domestic credit expansion, although foreign-asset accumulation was also an important factor.) Given the lags between money-growth changes and their impact on the price level, it appears reasonable to infer that the 1971-73 exchange-rate policies of the four Pacific Basin countries aggravated their inflation problem in 1974-75.

Second, in the case of downward exchange-market pressures, our analysis suggests resisting depreciation and using reserve depletion to help bring about a monetary contraction. All four countries experienced strong downward pressures during 1974-75; but all except Taiwan responded by letting their currencies depreciate. Taiwan, in contrast, relied on a heavy reserve drain to effect a sharp drop in its money-growth rate, from 49 percent in 1973 to 7 percent in 1974. It paid dearly for the monetary contraction, as real output grew only 2.2 percent in 1975, compared to its 10.4-percent average growth during the 1963-73 period.[13] But on the other hand, Taiwan's inflation rate dropped precipitously from 35 percent in 1974 to only 2 percent in 1975.

Third, the evidence suggests that our policy rule is not a necessary condition for domestic price stabilization. Japan intervened heavily in the exchange market to moderate yen appreciation in 1968-78. Nevertheless, Japan also managed to hold down the money-growth rate, and thus successfully wound down inflation over a several-year period. Korea similarly was unwilling to appreciate its currency in the face of mounting exchange-market pressure; but through drastic trade-liberalization measures, it was able to reduce its payments surplus in 1978 and win at least a temporary respite from the exchange-market pressure. Thus, our policy rule is by no means absolute. The same anti-inflation policy objective could be achieved through measures other than an appropriate exchange-rate policy.

Finally, the suggested policy rule must be taken in its proper context. For analytical purposes, we assume that reducing domestic inflation is the only policy objective, that adequate foreign reserves or international credits are available on reasonable terms for financing temporary payments deficits, and that policymakers can permit an effective adjustment process (including monetary contraction) to correct a sustained payments imbalance. But in reality, not all of these conditions can be satisfied. For example, Korea probably had no choice but currency depreciation in 1968-71 and again in 1974, given the small size of her foreign reserves and a credit policy which was designed to promote domestic investment. Moreover, all four countries exhibited a strong aversion to currency appreciation and a strong preference for currency depreciation—an attitude exactly opposite to what our policy rule would prescribe. Presumably, their policy attitudes stemmed from other objectives, such as export competitiveness and income growth. Whether such an attitude is rational or not is a separate issue. What is relevant is that a "sub-optimal" exchange-rate policy incurs a cost in terms of a higher-than-necessary inflation rate.

FOOTNOTES

1. See International Monetary Fund, **Annual Report 1977,** Appendix II, "Surveillance Over Exchange Rate Policies," pp. 107-109.

2. See Lance Girton and Don Roper, "A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience," **American Economic Review,** September 1977, pp. 537-548.

3. See Peter Quirk, "Exchange Rate Policy in Japan: Leaning Against the Wind," **International Monetary Fund Staff Papers,** November 1977, pp. 642-664.

4. Robert A. Mundell, "The International Disequilibrium System," **Kyklos,** 1962, pp. 153-170, reprinted in his **International Economics,** 1968, Ch. 15, pp. 217-232; and his "The Appropriate Use of Monetary and Fiscal Policy for Internal and External Stability," **International Monetary Fund Staff Papers,** March 1962, reprinted in his **International Economics,** 1968, Ch. 16, pp. 233-239.

Marcus J. Fleming, "Domestic Financial Policies Under Fixed and Under Floating Exchange Rates," **International Monetary Fund Staff Papers,** November 1962, pp. 369-380.

For a survey of the early contributions, see Marina v.N. Whitman, **Policies for Internal and External Balance,** Special Papers in International Economics, No. 9, Princeton University, December 1970.

For a recent study that also deals with the relationship between the exchange-rate policy and the domest-

P.O. Box 7702
San Francisco, California 94120

ic price level, see Stanley W. Black, **Exchange Policies for Less Developed Countries in a World of Floating Rates,** Essays in International Finance, No. 119, Princeton University, December 1976.

5. The analysis is comparative-static and thus does not consider any short-run effect of monetary changes on real output.

6. See Don Patinkin, **Money, Interest, and Prices,** 1956, p. 59 and Mathematical Appendix 4:b-c, pp. 309-311.

7. The proof in terms of money-market analysis is quite simple. Although the money market is not expressly considered, it is nevertheless subsumed in the model involving the goods markets only. By Walras' Law, in the absence of a bond market, the goods markets are a mirror image of the money market; whatever holds for the goods markets must also hold for the money market, and vice versa. In the present case, the output expansion in the tradable-good sector corresponds to a rise in the demand for money balances in the money market as a result of increased real income or wealth. Given the unchanged money supply, equilibrium in the money market can be restored only through a decline in the aggregate price level.

8. According to unpublished regression results obtained by Michael Bazdarich, the average lag between money expansion and price inflation in Japan was about eight quarters on the basis of 1958-1977 data.

9. A complete explanation of Japan's inflation of 1973-74 lies outside the scope of this paper. That inflation can be considered as part of the world inflation phenomenon which was analyzed in four articles in this **Review,** Spring 1975, by Edward S. Shaw, Michael W. Keran, Hang-Sheng Cheng and Nicholas P. Sargen, and Joseph Bisignano.

10. International Monetary Fund, **International Financial Statistics Yearbook,** 1979.

11. At the end of 1974, the Bank of Korea held only $277 million in foreign reserves, while other domestic banks had $774 million in foreign assets against $1,073 million in foreign liabilities. The current-account deficit amounted to $2.0 billion in 1974. International Monetary Fund, **International Financial Statistics,** September 1979.

12. For a study of the role of the 1974 won devaluation in the improvement of Korea's trade balance, see Hang-Sheng Cheng, "Alternative Balance-of-Payments Adjustment Experiences: Korea and Taiwan, 1973-77," this **Review,** Summer 1978, pp. 37-48.

13. Ibid., p. 44.